TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, JOHN M. SAVAGE, Jr., a citizen of the United States of America, residing in Solana Beach, in the County of San Diego, State of California, have invented a new and useful improvement in

THREADED LENS COUPLING TO LED APPARATUS WITH COMPRESSIBLE LOCKING RING

BACKGROUND OF THE INVENTION

This application is a continuation-in-part application of Serial No.10/259,126, filed September 27, 2002.

This invention relates generally to generation and transmission of light, as from an LED source or sources; and more particularly concerns improvements in coupling devices enabling such transmission of light.

There is need for improvements in apparatus and methods to overcome deficiencies and problems with prior coupling system.

SUMMARY OF THE INVENTION

It is a major object to provide improved apparatus and methods as referred to. Basically, the invention provides an improved lens adapted for transmission of light comprising

a) a lens body, defining an axis,

b) threading on the lens body extending about said axis, for reception in threading associated with the holder.

A further object is to provide threading on the lens body that includes multiple threads extending about said axis. Such threads are typically foreshortened to allow for tightening into the threading associated with the holder in less than about one full turn of the lens relative to the holder.

An additional object is to provide such threads on the lens body that extend only part way about the axis, as for example only about one-half way about the axis. Six such threads may advantageously be provided, to extend peripherally of the body, spiralling about the axis.

Yet another object is to provide a lens holder that extends only part way about said axis. As will be seen, the holder may extend about the lens threading, the holder threading having axial extent greater than the axial extent of such threading on the lens.

A yet additional object includes provision of threading associated with the holder includes multiple threads each having more than one full turn about the lens body, and the threading on

the lens body includes multiple threads each having less than one full turn about said axis.

The threading associated with the holder advantageously including six threads each having about two full turns about the lens body, and the threading on the lens body includes six threads each having about one-half full turn about said axis.

A yet further object is to provide lens threads and connector mating threads or retaining ring threads configured to permit the mating parts to be push onto the lens and than with a half a turn to secure the two parts together. This feature prevents the wire leads of the connector from being twisted during installation.

An additional object is to provide thread pitch that allows for the connector or retaining ring and lens to be secured in only one full turn. In this regard connector and retaining ring may have six separate half threads with equally spaced wrap around the diameter. The lens mating six threads typically have two full turns which permits the units to be secured to varying thickness panels

for example from a 32nd of an inch to 1/4th inch thick.

Additionally, the mating lens and connector or retaining ring may be configured to be secured by hand tightening. If the connector or retaining ring are tightened past the secure point then the threads will slip back into a previous thread. This feature prevents the plastic threads of the lens, connector or retaining ring from being stripped. Also, when a rubber or metallic grommet is used between the panel and the connector or retaining ring, it functions as a locking unit. As the connector or retaining ring is tightened the grommet will compress. This compression causes backpressure on the threads of the mating parts providing a locking means. When a rubber seal is installed between the lens and the panel it prevents the entry of water and dust through the panel opening.

A further object is to provide a metallic locking ring that has teeth or projections to be axially compressible in bending mode. Certain teeth have ends that project in one axial direction to engage a mounting panel and other teeth have

ends projecting in the opposite axial direction, to engage the end face of the holder.

An added object is to provide for leads of a 10mm LED to be installed, using A and B entry ports, a terminal being located in each of the chambers beneath the entry ports completing the electrical connection. A four leaded flux LED can be accommodated using the four connector entry ports with their associated terminal contracts. The connector's four box terminals permit electricity to be introduced into three of the four LED leads while the fourth lead is common to all. The LED can then emit a full range of colors by electrically exciting various combinations of the LED leads.

Yet another object is to provide a method of extracting heat from the LED via connector terminals, which prevents over heating and extends the operating life of the device. As will be seen, the LEDs can provide a point source of light. The lens may have Fresnel rings, which disperses the LED point source of light and spreads it over the entire lens surface, providing a wide viewing angle.

These and other objects and advantages of the invention, as well as the details of an illustrative embodiment, will be more fully understood from the following specification and drawings, in which:

DRAWING DESCRIPTION

Fig. 1 is a side elevational view of the preferred form of threaded lens;

Fig. 2 is an end elevation taken on lines 2-2 of Fig. 1;

Fig. 3 is a lengthwise section taken on lines 3-3 of Fig. 2;

Fig. 4 is a right end elevation of a lens holder, defining a connector having six terminals;

Fig. 5 is a section taken on lines 5-5 of Fig. 4;

Fig. 6 is a view like Fig. 5, but rotated 90° about an axis defined by the holder;

Fig. 7 is a left end elevation of the holder taken on lines 7-7 of Fig. 6;

Fig. 8 is a section taken through an

alternative lens holder in the form of an interiorly threaded retaining ring;

Fig. 9 is an end view of the Fig. 8 ring, taken on lines 9-9 of Fig. 8;

Fig. 10 is a side elevation taken on lines 10-10 of Fig. 9;

Fig. 11 is a side view of a terminal plug with four pins useful to plug into four receptacle terminals as seen in Fig. 4;

Fig. 12 is an enlarged view of a receptacle terminal;

Fig. 12a is an end view taken on lines 12a-12a of Fig. 12;

Fig. 13 is an enlarged view of a receptacle terminal receiving endwise reception of a terminal pin;

Fig. 14 is a view like Fig. 13 showing centering and interference connection of the pin to the terminal;

Fig. 14a is an end view taken on lines 14a-14a of Fig. 14;

Fig. 15 is a side elevation showing a plug carrying an LED or LEDs, and having two terminal pins;

Fig. 15a is an end view taken on lines 15a-15a of Fig. 15;

Fig. 16 is a top plan view showing another form of plug carrying an LED or LEDs, and having four terminal pins;

Fig. 16a is a side elevation taken on lines 16a-16a of Fig. 16;

Fig. 16b is a side elevation taken on lines 16b-16b of Fig. 16;

Figs. 17-20 are enlarged fragmentary sections showing progressive connectors of an interiorly threaded retaining ring to an exteriorly threaded lens, in relation to a mounting panel;

Fig. 21 is axially exploded view of a threaded lens, threaded retainer ring and a locking ring also serves as a moisture seal, this being a preferred application of the threaded lens;

Fig. 22 is a view of the Fig. 21 components, in axially assembled relation;

Fig. 23 is a view like Fig. 22, showing the locking ring and moisture seal component assembled in an alternate position;

Fig. 24 is an exploded view of a threaded lens, threaded holder with connector terminals, pin

terminals; LED plug having four terminals, and locking ring and in relation to a mounting panel;

Fig. 25 is a section showing the assembled positioning of the lens, panel and locking ring of Fig. 24;

Fig. 26 is a section showing the assembled positioning of the holder, LED plug, connector receptacle terminals, and supply power pin terminals;

Fig. 27 is an axially exploded view of a threaded lens, threaded holder with connector terminals; pin terminals, the LED plug having two terminals; and locking ring, in relation to a mounting panel;

Fig. 28 is a section showing assembled positioning of the holder, locking ring, LED plug, connector receptacle terminals and supply power pin terminals, of the Fig. 27 components; and

Fig. 29 is like Fig. 28, but showing the locking ring in position forward of the mounting panel.

Fig. 30 is a view showing provision of a metallic locking ring, fitting on a lens body,

between a panel and a holder being assembled onto the lens body;

Fig. 31 is an axial view of the metallic locking ring, on the lens body threading; and

Fig. 31 is an enlarged edge view of the locking ring showing ends of radially projecting teeth projecting at opposite sides of the ring, to be resiliently compressed upon make-up between the holder and panel seen in Fig. 30.

DETAILED DESCRIPTION

Referring first to Figs. 1-3, a lens 10 is adapted to be secured to a holder, to be described, for transmission of light, as for example from an LED or LED array. The lens 10 has a body 10a defining a central axis 11, and the body is shown as generally cylindrical defining an inner surface or bore 11a, an outer surface 12, and opposite ends 13 and 14. End 14 is shown in the form of an integral cap having a dome 14a, and an outwardly projecting annular flange 14b. The inner side of the dome defines Fresnel rings 15, for diffracting light rays impinging in direction 17 on

the rings, diffused light exiting from the convex outer side 18 of the dome. The body may consist of molded plastic material.

Threading indicated at 19 is formed on the lens body extending about said axis, for reception in threading associated with the holder. Such threading spirals about axis 11, while advancing in direction 17, as shown. Typically, multiple such threads 19a are employed, and are alike. The threads are foreshortened in length to allow for tightening into mating internal threading associated with the holder, to be described, in less than one full rotary turn of the lens 10, relative to the holder. Each thread 19a extends only part way about the axis 11 at the lens body periphery, and preferably six threads 19a are employed, each of which extends only about half way (180°) about axis 11.

Figs. 5, 6 and 24 show one form of lens holder 25, which is also integral with a reduced diameter connector 25a at one end 26 of the holder. The opposite end 27 of the holder is centrally open at 27a, for threaded reception of the lens body 10a, as the holder is rotated. At that time, the

lens is typically retained by or mounted to a panel 28, as shown in Fig. 25, with a locking ring 29 mounted on the lens body and engaging wall 28a of the panel, and lens flange 14b engaging the opposite wall 28b of the panel.

Figs. 17-20 and 21-23 also show provision of a modified lens holder in the form of a retaining ring 31. That ring has internal threads at 32, the same as the internal threads 30 the holder 25. See also Figs. 8-10.

Lens threads and connector mating threads 30 or retaining ring threads are formed to permit the mating parts to be pushed onto the lens and then with a half a turn, secure the two parts together. This feature prevents the wire leads protruding from the connector as at 85 from being twisted during installation. Additional turning of the connector during assembly would tend to cause excessive torque on the wires, which would cause an opposing twisting action on the connector.

The pitch of the threads allows for the connector or retaining ring and lens to be secured in only one full turn. The connector and retaining ring typically have six separate half threads,

equally spaced wrap around the diameter. The lens mating six threads have two full turns which permits the units to be secured to varying panels from a 32nd of an inch to 1/4th inch thick.

The mating lens and connector or retaining ring are configured to be secured by hand tightening. If the connector or retaining ring are tightened past the secure point, then the threads will slip back onto a previous thread, as by over-crest slippage seen in Figs. 19 and 20. This feature prevents the plastic threads of the lens, connector or retaining ring from being stripped.

When a rubber grommet is used between the panel and the connector or retaining ring it functions as a locking unit. As the connector or retaining ring is tightened the grommet will compress. This compression causes backpressure on the threads of the mating parts providing a locking means.

When a rubber seal is installed between the lens and the panel it prevents the entry of water and dust through the panel opening.

Figs. 17-20 show the thread interfitting sequence of the lens and holder elements, and the

functioning of the compressible locking ring 29, which may consist of elastomeric material, such as rubber. The locking ring may alternatively consist of axially compressible metallic material, to be resiliently compressed as the holder is tightened on the lens body, creating pressure and locking friction at thread to thread interengagement locations. The metallic ring may have the general configuration of ring 29.

Note in Figs. 22 and 23 the reception of an LED plug type unit 34 into the interior 10c of the lens 10, with the dome 34a of unit 34 proximate the Fresnel rings at the concave interior side of the lens cap end 14. The leads 37 of the LED unit project from or through a circuit board 38 to which the leads are mounted, to support the unit 34. A flange 34b on unit 34 is closely received in the bore of the lens, at location 40, for centering. The lens has threaded attachment to the holder 31 as shown, and as described above. Holder ring 31 includes integral annular stiffeners 41 projecting outwardly. Ring 31 may consist of molded plastic material.

Figs. 27 and 28 show the plug type LED unit 34 assembled to a connector 25a as described above, the internal threads of holder 25 assembled to the lens threads at 44. The domed end 34a of unit 34 is received into the lens interior as described above; and locking ring 29 is held in compressed condition between the left end face of the holder and the panel 28. The two pins or leads 37 of the LED unit are received into two parallel female terminals 46 received into and carried by slots 47 in the connector 25a.

Figs. 12-14 show progressive reception of a pin or lead 37 into a terminal 46. The tapered end 37a of the pin or lead penetrates into the tubular body 50 of the terminal, and between tapered guide 51 and internal barb 52. The guide and barb project laterally into the interior 50a of the body 50, with the guide slidably guiding the pin, and the barb 52 having an edge 52a riding along the side of the pin, with friction, to center the pin in the interior 50a. Edge 52a also gouges into the side of the pin to block endwise retraction or loosening of the pin from the

terminal. Both 51 and 52 are resilient cantilever spring fingers. Wiring is retained to 46 at 46a.

Another form of LED unit is seen at 60 in Figs. 11, 16, 16a and 16b. Unit 60 has a polygonal body 61, a domed end 62 from which light is emitted, and four pins 63 located at corners of a square. Those pins or leads are adapted to receive controlled electrical energization as from a circuit 64, to control different colored light emission from three LEDs in the unit, the fourth pin being a common or ground. Color emission from unit 60 can thereby be controlled, by light color mixing within 60, for emission from domed end 62. Figs. 24 and 26 show pins or leads 63 endwise received within, and electrically connected, to four female terminals 65. The latter are in turn received in four slots 66 in the connector 25a. A control circuit appears at 64, as in Fig. 16. See also Figs. 5 and 6.

The connector 25a of Figs. 4-7 is configured to receive the pins of either type LED unit, 34 or 60, i.e. it has four slots 66 at corners of a square, to receive the four terminals 65 of a unit 60. It also has two slots 47 to

receive terminals 46 of a unit 43. Slots 47 are located within the square (see Fig.7) defined by slots 66. A highly versatile and compact connector 25a is thereby provided.

The connector terminals also provide a method of extracting heat from the LED, which prevents over heating and extends the operating life of the device.

Figs. 29 and 30 show use of a moisture sealing ring 29 located in a groove 29a in the lens body, adjacent the periphery of the lens 10, to seal against the outer side of panel 28.

In Fig. 30, a lock washer 75 fits over the lens threads 44 at the opposite side of panel 28. The flat metallic washer has radially inwardly projecting teeth 76 which mesh with the threads 44 or thread grooves 44a, as seen in Fig. 31. The radially inner ends 76a and 76b of alternate teeth also project away from the plane of the washer, at opposite axial sides thereof, to grip the panel 28 and the end face 25c of the holder 25, as the assembly is made-up, thereby locking the assembly in made-up condition. See Fig. 32. The teeth 76

are axially resilient compressible, in bending mode, during make-up.